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ABSTRACT
        This guide accompanies "Special Effects," a 40-minute IMAX
film and "Special Effects II", a multimedia, interactive traveling exhibit
designed by the California Museum of Science and Industry. The exhibit
focuses on the underlying scientific and technical processes of special
effects from the earliest motion picture to state-of-the-art digital computer
graphics. The guide contains activities, questions, and projects that allow
students to create and further uncover the mystery of special effects.
Contents include: (1) "Science Concepts"; (2) "More Than Meets the Eye
(Perception)"; (3) "A Matter of Perception (Perception)"; (4) "Monsters,
Motion, and Mechanics (Physics)"; (5) "Mysterious Makeup and Preposterous
Props (Chemistry)"; and (6) "High-Tech Reality (Technology)." (CCM)

SPECIAL EFFECTS

Activity Guide

The Special Effects Project

NOVA®/WGBH Boston and the California Museum of Science and Industry have joined together to present the following film and exhibit.

Special Effects II is a multimedia, interactive traveling exhibit designed by the California Museum of Science and Industry that opened in December 1994. Scheduled to travel to 15 other museums and science centers in North America between 1995 and 1999, the exhibit focuses on the underlying scientific and technical processes of special effects, from the earliest motion pictures to state-of-the-art digital computer graphics.

Special Effects is a 40-minute IMAX®/IMAX Dome film produced by NOVA/WGBH Boston with the participation of 14 U.S. and 4 international science museums. The film shows how special effects filmmakers use their understanding of the human visual system to create movie illusions. Special Effects is distributed by Imax Corporation.

Credits

This guide is produced by NOVA/WGBH Boston and the California Museum of Science and Industry.

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Educational Outreach Advisory Committee

Film Science Advisors

Special Effects is presented as part of the Motion Picture Centennial: Years of Discovery, 1891–1896/Years of Celebration 1991–1996, a six-year, nationwide, multi-institution observance of the first 100 years of the moving image arts.

MOTION PICTURE CENTENNIAL

Years of Discovery
1891·1896
Years of Celebration
1991·1996

WGBH

CMSI

Lights! Camera! Special Effects!

As you watch *Special Effects* on the giant screen of IMAX/IMAX Dome and other large-format theaters, you will learn some of the key tricks that special effects artists use to create convincing illusions for blockbuster movies. These movies have budgets of many millions of dollars, but with a few household items you can explore the same scientific principles that professionals use.

Contents

This guide is your escort into the world of motion picture magic, with projects that allow *you* to create special effects. You will find activities that explore what makes us susceptible to certain illusions. Read the **questions** at the start of each section then do the **activities** to uncover the mysteries behind special effects. To find out more about your discoveries, check out **Behind the Scenes** to learn about how science plays a role in what you've done. And don't miss the **Close-Ups,** which tell you how some of today's top special effects experts got into one of the world's most unusual professions. It's all in the magical world of special effects.

Is This Guide for Me?

Are you someone who likes to have fun? Then yes, this guide's for you! If you're in upper elementary or middle school, then you're just the right age to do these activities (you don't have to see the film to do them). Your parents and teachers might see how much fun you're having and want to join in—go ahead and let them (otherwise they'll never leave you alone). And tell them the science concepts for these activities are on pages 2–3 (so they can figure it out, too!).

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Science Concepts

More Than Meets the Eye
Science concept: perception (eye and brain)

1 "Color Scheme"
Mix construction paper cutouts with real objects to see how color serves as a powerful cue to a thing's identity.

2 "Now I See!"
See how fast you can identify a moving object and learn how the structure of the human visual system influences the perception of motion, shape, color, and clarity of image.
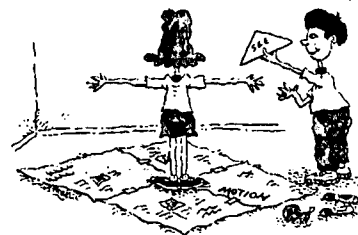
A Matter of Perception
Science concept: perception (eye and brain)

1 "Flip into Action!"
Make a flipbook to explore how the visual system and brain work together to perceive motion.
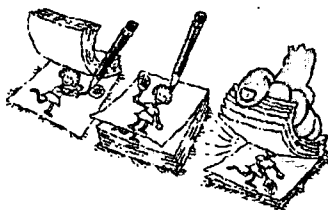
2 "So Close and Yet So Far"
With balloons and coins, discover how the brain utilizes visual clues to judge the distance and relative position of objects.
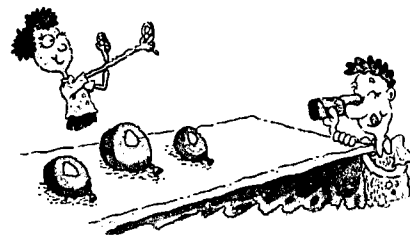
Monsters, Motion, and Mechanics!
Science concept: physics (motion and machines)

1 "Stunt Car Drivers"
Use miniature racecars to learn how the motion of a moving object is altered by applied forces.

2 "What's Walla?"
Make your own movie soundtrack and discover how sounds may be simulated by producing similar vibration patterns electronically or with other objects.

Mysterious Makeup and Preposterous Props!
Science concept: chemistry (properties of materials and reactions)

1 "A Frosted Windowpane"
Create "frost" that never melts to understand that crystals are solids that form when a liquid evaporates.
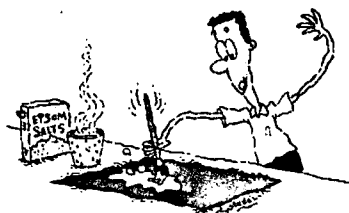
2 "A Bone to Pick"
Turn chicken bones rubbery and discover that chemical reactions produce new materials with properties different from the substances that combined to make them.
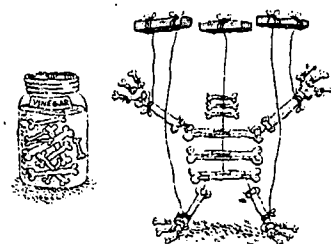
High-Tech Reality
Science concept: technology (computers and communications)

1 "Too Good to Be True"
Use your own cartoon movie scene to discover that, despite its many advantages, computer technology cannot duplicate the natural imperfections and differences in living things.

2 "Happy Trails, Mr. Circuit"
Make a special effect with a simple circuit and learn that it includes a closed patch, a switch, a load, and an energy source.

3 "Fish Gotta Swim"
Make a fish "swim" through water and see how an object that seems to be moving might be doing the opposite —standing still.
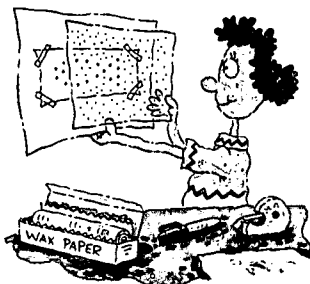
4 "Shoebox Studio"
Make your own movie studio with a shoebox, action figures, and magazines and observe that the relative position of objects in a limited frame of reference determines how they are perceived.

3 "What Did You Expect?"
Show some basic shapes to your friends, tell them a story about the shapes and learn how the brain uses patterns and contextual clues to determine the identity of objects.

4 "Out of the Blue"
Duplicate the special effect "blue screen" and see how technology, based on an understanding of light and color, permits action on one location to be combined with other action, scenery, or characters filmed at a different time or location.
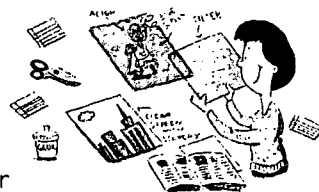
3 "The Creature from the Backyard"
Draw a "storyboard" of a roly-poly bug and study how animals move in distinct ways which can be observed and related to specific stimuli in their environment.

4 "'It's a Bird, It's a ..., It's Flying!'"
Create your own miniature flying harness and explore how simple machines alter the direction and magnitude of a force.
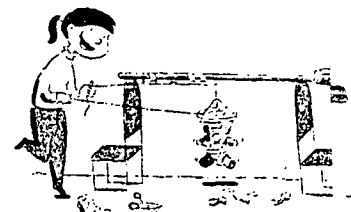
3 "Prop Rocks"
Make different-sized rocks from plastic foam and observe how the different densities (mass per unit volume) of substances affect how they interface with other matter.
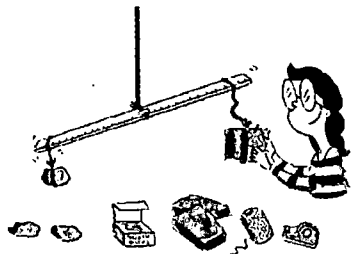
4 "Mad Scientist's Lab"
Experiment with kitchen science to see that matter has properties, including elasticity, density, color, and texture that define how it behaves.
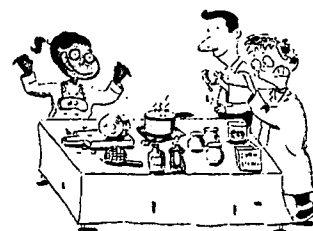
3 "A Square Image"
Use different sizes of graph paper to reproduce a photograph and observe that the quality of information improves with the density of information.
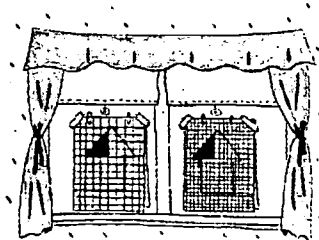
4 "Give Me a Hand"
Create an animated hand and explore some of the many new ways computers can be used in animation.

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Is Seeing Believing?

Have you ever been fooled by something that wasn't what it appeared to be?

A piece of lint that looked like a bug?

Hand cream that you mistook for toothpaste?

A shadow that looked like your next-door neighbor?

Special Effects: Preparing to film King Kong atop a skyscraper.

Most of the time we experience the world without making serious errors. We have learned to interpret clues of color, form, light, motion, and depth to orient ourselves in the world. Occasional mistakes, as in the examples to the left, occur when we misinterpret the clues. The art of special effects relies on supplying just the right clues to convince the audience that something is real when it isn't.

In order to fool the eye, it helps to know how the eye works. Often compared to a camera, the eye is actually much more complicated than that. A camera cannot adapt to light nearly as well as the eye can because camera film is not as sensitive or as dynamic. Most importantly, the eye is connected to the brain, which constantly analyzes and interprets all the information coming into the eye, allowing for special perceptions such as motion and shape.

For example, imagine you're looking at a mountain range or block of skyscrapers. You can see people and cars in the streets beneath the mountains or tall buildings. You can also see telephone poles and trees. Your brain instantly tells you that the mountains or the skyscrapers look big in relation to the cars and telephone poles. You take a photo, but when it comes out you're disappointed. The mountains and buildings look so tiny! They were really much bigger, you think. But their bigness was an impression that your mind created by comparing the mountains or buildings with the objects around them.

Special effects rely on tricks of perception. Say you're watching *Star Wars*, for example. One spaceship is chasing another above a planet. The motion is so smooth and convincing. You almost feel pressed into your seat as the rockets accelerate across the screen. In reality, the spaceships are models, the planet is a painting, and all that's moving is the camera. But who would interpret it that way except for the people who made the film? For everyone else, their brains tell them that spaceships are fighting it out over a planet.

But now *you* know how it's done. And you can find out lots more about special effects. Just turn the page to start your journey.

Feeling Queasy?

Audiences at IMAX/IMAX Dome and other large-format theaters are often warned they may feel queasy during parts of the film. Why does this happen? When you seem to be peering over a cliff or speeding down a highway, the parts of your body that let you know when you're off balance—your inner ear and muscle and joint receptors— are saying, "Hey, no problem, everything's fine." But your visual system and brain are yelling, "No it's not. I'm fall-ing!!!" or: "Get me out of this crazy car!!!" Combining these contradictory clues with a really big visual field makes this illusion more effective. If you begin to feel sick, sit back, shut your eyes, and feel the firm, unmoving seat that anchors you in a rock-solid theater that really isn't going anywhere.

emember hearing about the scene where the original King Kong peers out from the side of the Empire State Building? How could you forget? But what exactly was that? Was it really Kong, or just his head? Was it really his head, or just a fuzzy brown costume worn by an actor? How do filmmakers use what is known about human perception to show us just enough so that we believe what they want us to believe? Hmmm. It's ...

More Than Meets the Eye

How have things been looking lately? OK, you say? No problem telling your dog apart from that shadow on the wall? Good thing, because in the movies there's no telling what's real and what's not. Are there people whose job it is to use what they know about how you see to make things seem real that aren't? You bet!

1 How do you create a cast of thousands?

2 Do you always see what you think you see?

3 Which moves, the fish or the water?

4 When are people bigger than monsters?

Hey, cool questions. Find out more on the next page.

Color Scheme

"A cast of thousands!" How many Hollywood films have been promoted with that promise? But thousands of what? People? Martians? And are there really thousands of them? Try this project to shed light on the illusion of endless crowds on the screen.

- **You will need:** assorted colors of construction paper, scissors, colored pencils, a collection of objects of the same color, such as a bunch of carrots, a bouquet of identical flowers, a bowl of apples, a bag of candy corn, or a stack of blocks.

- Select a piece of construction paper that is close to the same color as your collection of objects. Cut the paper into the shape of the object. Arrange the cutout with the group of objects. Place the arrangement at one end of a room.

- Now bring a friend into the other end of the room. Ask her how many objects there are. What happens?

- If your friend notices that one of the objects is really a cutout, try making the cutout look more realistic by using colored pencils to give it

shading or other features. You can also try arranging or lighting the objects differently. Then try the test on another friend.

- When you succeed in fooling your friends, try making the cutout *less* realistic. What is the crudest shape that you can get away with? How important are color, shape, and lighting to creating the illusion that the cutout is one of the objects? Is anyone fooled by looking at the cutout all by itself?

- Try placing different cutouts around your home, such as a green-leaf shape in a plant, or a yellow shape in a bunch of bananas. You may find that, when you pass by, even you are fooled!

Want to know more about your discoveries? Check out **Behind the Scenes** on page 8.

2 Now I See!

A shaking branch, a ripple in a pond, a puff of smoke in the distance—have you ever noticed tiny movements like these? In our shifting awareness of the world around us, motion is one of the first things we detect. But at what point do we notice the shape of something, or its color, or its details? Grab a friend and see.

- **You will need:** four pages of newspaper, tape, assorted colors of construction paper, scissors, a colored marker, and a black marker.

- Cut out a triangle and a circle from a sheet of construction paper (the two shapes should be about 4 inches across). Cut another triangle and circle of the same size from a different colored sheet. On each of the four shapes, write "see" on one side and "sea" on the other, using the black marker.

- Tape the four pages of newspaper together edge to edge, place them on the ground, and stand in the middle of the big sheet. Have your friend use a marker to outline your feet.

- Raise your arms straight out to your sides. Look straight ahead and focus your eyes on a particular spot.

- Ask your friend to walk around you very slowly holding one of the four

shapes. The path your friend takes should be a circle, just outside the reach of your outstretched arms. The object should be at eye level.

- Starting from behind you, your friend should walk slowly around you. Look straight ahead. Say "stop" when you first see something moving. Have your friend write "motion" on the newspaper at that point.

- Repeat the process, only this time say "stop" when you can see the *shape* of the object. Have your friend write "shape" at that point. Do this two more times, saying "stop" once when you see color and once when you can read the word. Have your friend write "color" and "detail" at these points.

- Change places with your friend and repeat the activity with a different shape. Mark these results in a different color.

- What do you notice about the ways you see motion, shape, color, and detail? Where did you see each?

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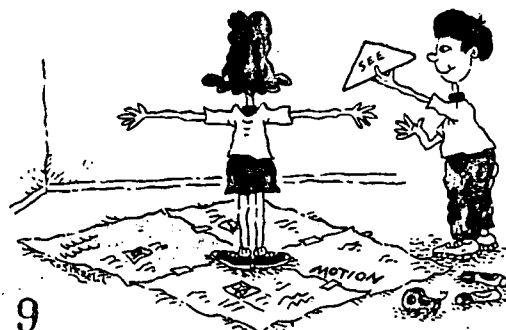
3 Fish Gotta Swim

Without relative motion—one thing moving past another—we'd be marooned in an unchanging world, unable to orient ourselves to anything around us. Sound like a scary science fiction movie? Try this activity.
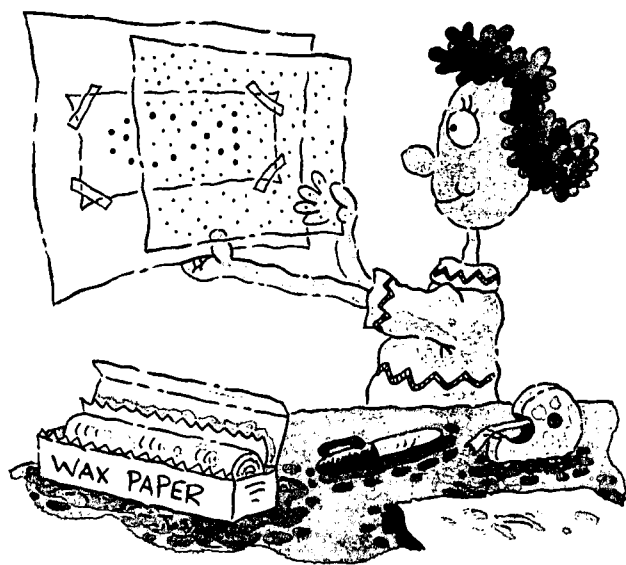
● **You will need:** two sheets of wax paper, one 10 x 12 inches and one 5 x 12 inches, a black marker, one sheet of white paper about 11 x 17 inches, and tape.

● Using the marker, cover one entire side of the large sheet of wax paper with black dots, roughly one-half inch apart (see illustration). Make the pattern as random as possible. It doesn't matter if some dots are closer together than others.

● On the small sheet of wax paper, make an outline of a fish using black dots that are about one inch apart.

● Orient the white paper horizontally (the long way), and tape the fish in the center so that it is facing to your left.

● Now your fish is ready to swim! Place the large sheet of wax paper over the fish. Where's the fish? Slowly move the large sheet to the right. Do you see the fish?

● Try moving the fish to the left while keeping the large sheet stationary. Does it make a difference in how you perceive the motion? Be sure and try this experiment on your friends.

4 Shoebox Studio

Ever have a day when you wished you were bigger than King Kong? In your Shoebox Studio you can be any size you want. It's all a matter of perspective.

● **You will need:** a shoebox, a small pair of scissors, several magazines (catalogs and travel magazines work well), 4- x 6-inch index cards, a small photo or drawing of yourself, glue, and a small plastic monster figure.

● Cut an eyehole about 1/2 inch in diameter in one end of the shoebox. This will be your camera viewfinder.

● Cut out a magazine picture backdrop that shows where your scene takes place. Put it at the other end of the shoebox so you can see it through the eyehole.

● Next, cut out any scenery and props you would like (such as buildings, trees, and furniture).

● Cut out a piece of an index card about the size of the photo or drawing of you, leaving an extra inch of the card at the bottom. Glue the photo or drawing to the top of the card. Fold the card so that your photo is at a right angle to the extra inch of the card at the bottom. This should allow "you" to stand up. Repeat this with your scenery and the props.

● Arrange your photo, monster, scenery, props, and you in the shoebox so they're ready for their scene. Look through your eyehole to make sure it's the way you want it.

● Can you make yourself bigger than the monster? How can you do it?

● How else can you use the different sizes of images to create your own special effects?

Close-Up

Ticket to: It's All in Your Mind

Next time you're at the movies, note the apparent size of the screen from where you're sitting. Measure it by extending your arm and counting how many palm-widths high it is. How close do you have to sit to a TV for its screen to appear the same size? If you sit that close, does the TV picture seem as big as the picture at the movies? Why or why not?

Ticket to: Pictures Never Lie.... Not!

Magazine advertising is filled with special effects. Thumb through your favorite magazines and pick the photos that do not look like they are real. Why do you think they're not real? How do you think they were done? Why?

Behind the Scenes

1 Color Scheme

Hardly anyone would think that a cutout orange piece of paper was a carrot. But put it in with a bunch of real carrots and people are easily fooled. Color can serve as a powerful cue to the identity of something. A bright red rectangle speeding down the street is interpreted as a fire truck, even if all you see is a blur. By contrast, a fire truck painted with black-and-white stripes would definitely cause confusion. Movie directors rely on our conditioned expecta-tions about color to make us believe they have lots of something, when actually they only have a few things.

2 Now I See!

You may think that everything in your field of vision is laid out in sharp detail that you perceive all at once. But it's not true. Your eyes are always on the move, assembling a picture of your surroundings bit by bit. As this experiment shows, you can detect motion at the extreme edge of your field of vision; shape and color a bit closer to the center; and sharp detail only at the very center of where you are looking. Movies often direct our atten-tion by showing only certain parts of a scene in sharp focus. This imi-tates the way we see the world, so it looks real.

3 Fish Gotta Swim

Have you ever stood absolutely still in the middle of the woods? It's impossible to identify which branch belongs to which tree. But as soon as you move everything sorts itself out. The same effect makes the fish in this experiment visible as soon as it, or the "water," moves. Does it matter which moves—the water or the fish? Apparently not, for either way we interpret the fish as moving through the stationary water.

4 Shoebox Studio

Generally, we are able to look at what's around an object and perceive that objects don't change size based on how close or how far they are from us. However, when we limit what we can see around an object, then objects close to us appear larger than when they are farther away, even though they don't change size. This difference is called perspective. You should be able to make yourself bigger than the monster by moving "you" closer to the eyehole.

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f Elliot and E.T. could fly across the moon, why couldn't you soar over to the video arcade during lunch and be back in time for English class? You could—with some help from the special effects artists. For them, it's all ...

A Matter of Perception

Have you ever thought you saw something and then it turned out to be something else? Why do you think this happens? We use our brains to see, not just our visual systems. We practice figuring out what things look like and what they are from the moment we are born. Special effects artists use what they know about how we see and what we expect to see to make movies seem real. Curious? Don't worry, your brain can figure it out.

1 How does an animated movie bring drawings to life?

2 When is a small balloon bigger than a big balloon?

3 How fast can you identify something when it first appears in a movie?

4 What is behind E.T. and Superman flying?

Hey, cool questions. Find out more on the next page.
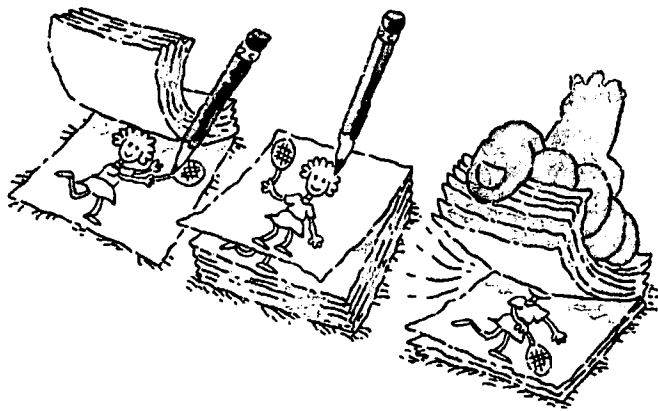
Flip into Action!

Have you ever wondered how cartoons are made? Find out by making one yourself.

● **You will need:** a three-inch-square pad of yellow self-stick notes, a pencil, and your imagination.

● Think of an object that you can draw easily. Then imagine it moving in some interesting way. (Remember, in the world of special effects, plants sing, milk cartons dance, and vegetables fly.)

● Place the stack of notes on the table with the sticky edge to the top. You will be drawing your flipbook from the back to the front.

● Draw your object in its final position on the *last* sheet in the pad. Remember, you are working backwards, so imagine that your object has just finished moving.

● Lay the second-to-the-last sheet on top of the last. Trace the parts of your figure that will not move. Then draw the moving parts in a *slightly* changed position.

● Repeat the process until you have 10 to 15 sheets. Each time you start a new sheet, trace the parts of the figure that will not move and make slight changes in the moving parts. Your top sheet should be the object as it is before it starts to move. Pick up the stack of self-stick notes and flip the pages rapidly from back to front. Watch what happens.

● Why do you think the figure appears to move? Does the action change if you go slower or faster? How is this like an animated cartoon?

2 So Close and Yet So Far

When is a big balloon not a big balloon? It all depends on your perspective.

● **You will need:** three different-sized balloons or balls, your breath, a table, an empty toilet-paper or paper-towel roll, a dime, and a quarter.

● Blow up the three balloons so that they are three different sizes. (You can also use three different-sized balls.) Arrange the balloons on the table so that one is close to you, one is in the middle, and one is far away. Using the toilet-paper or paper-towel roll as a camera, look at the balloons with one eye.

● Can you arrange the balloons to make the biggest balloon seem smaller? Can you rearrange them to make the smallest balloon seem closer or farther away?

● If you can fill in the blank in this sentence, you already know something about perspective. Objects close to me appear to be _____.

● Use what you know about perspective to make a dime and quarter the same size. Hold one in each hand and close one eye as if you are looking through a camera. Hold out your arms so that one hand is in front of the other. Line up the two coins so that the dime blocks your view of the quarter completely.

● Think about how you could use one of your plastic toys to make a movie monster. ...
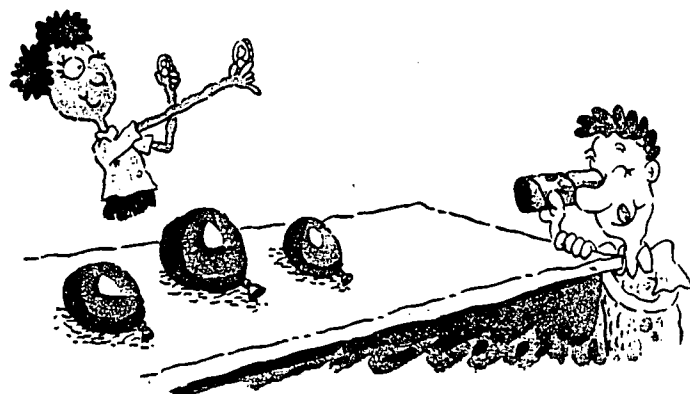
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3 What Did You Expect?

Sometimes in the movies you need to identify something very quickly without much information. (Is that a monster lurking in the bushes?) Your brain is good at making decisions like these. But what happens if you give your brain some suggestions? Try this activity on your friends.

● **You will need:** scissors, construction paper, tape, writing paper, and a pencil.

● Cut the construction paper into squares, triangles, and circles. Combine the shapes in several different ways so that they resemble familiar objects. For example, a square and a triangle can look like a house or two circles joined by a line can look like a pair of glasses. Tape the shapes together.

● Write a story a paragraph or two long that features the things you made with the shapes.

● Now it's time to call in a friend. Show your friend each of your shapes for one second (count "one thousand one") and then ask your friend what they remind her or him of. Record each answer.

● Find another friend and tell your story. Then show your friend each of the shapes for one second and ask what they look like. Write down your friend's answers.

● How are your two friends' answers different? Why do you think they are different? Try both parts of your experiment on lots of friends. How are the answers from the first group different from those of the second group? What conclusions can you draw?

● Why do you think scientists try to use big groups of people when they are conducting an experiment?

4 Out of the Blue
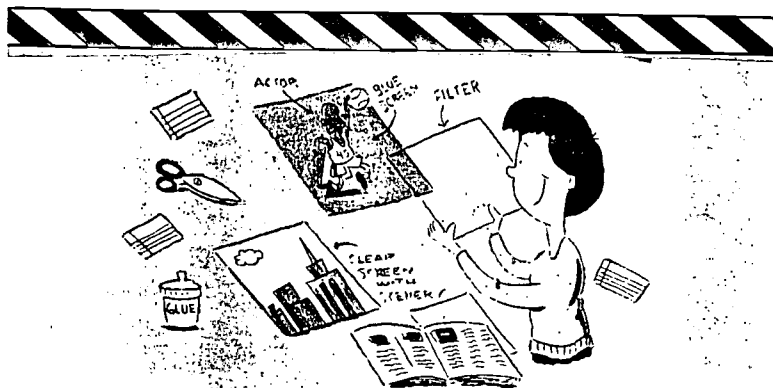
Q: What do E.T. and Superman have in common? A: A "blue screen." Using a blue screen is a way of filming an actor separately from the background of a scene so that E.T. can appear to ride a bike across the moon and Superman can fly over Metropolis. Let's see how this high-tech special effect works.

● **You will need:** five plastic see-through folders—one clear, one red, one blue, one yellow, and one green—several magazines, scissors, index cards, and glue.

● Your clear folder will be your scene. Cut out scenery from the magazines and glue it to the front of the clear folder. Make it as outrageous as you want, keeping in mind where you want your actor to go.

● Cut out your actor—or whatever you want to move through the scene—from a magazine, but don't glue it down.

● Now it's time to set up your blue screen. One of your colored folders will be your blue screen and the other your filter. Find the combination you want to use by putting one folder (the blue screen) on the table with your actor on top of it, and looking at it through a folder of

another color (the filter). You will use your clear screen later.

● When you find the right combination, the background should turn completely black, but you should still be able to see your actor. What two colors work best? Why? Is there more than one combination that works? Does a blue screen have to be blue?

● A colored filter stops certain other colors of light from getting through to your eye. What colors were blocked by the different filters you used?

● Put the scenery over your blue screen with the actor in between your clear screen and your blue screen. Look at it through your filter.

● Glue a little piece of folded index card to the back of your actor. Cut a slit in your blue screen so that you can move the actor through the scene.

Close-Up

Nilo Rodis

Job: Freelance production designer

Duties: Responsible for how movies look; that is, location, color scheme, costumes, sets, props, titles. Created initial sketches of Buzz Lightyear for Toy Story.

Major films: The Empire Strikes Back, Raiders of the Lost Ark, Return of the Jedi, Flubber

Education: B.A. Industrial design

Advice for beginners: "Stay in school. Use your imagination. When my little girl talks about riding on a bird, I don't say it can't be done. I encourage her to let her mind soar."

The coolest thing about the job: "Every movie project is different, with a different group of interesting people. You'll never have the opportunity to work in exactly the same situation again, so you enjoy it and learn all you can from each other."

Ticket to:

Raiders of the Lost Movie Frames

Movie frames move at 24 frames per second. How many frames are in an hour-long movie? Estimate how many hours it would take to make an animated film if an artist drew each frame by hand. How could you organize an animation studio to make this more efficient? How might computers help?

Behind the Scenes

1 Flip into Action!

Like the movies, animated cartoons are a series of still pictures. When we look at something, our brains retain the image for a fraction of a second. If the same image follows immediately in a slightly different position, our brains interpret the change as a movement. Animated cartoons and movies use 24 still pictures per second to create the appearance of a single moving image. A flipbook works best at that speed, too.

2 So Close and Yet So Far

Seeing is more than our eyes taking a picture. Our brains use clues from what is around an object to decide how big or how close it is. As long as we have enough information about what's around an object, we will perceive its correct size. However, when we view objects through a tube, the surrounding information is gone and objects close to us appear larger than when they are farther away, even though they remain the same size. This difference is called perspective.

3 What Did You Expect?

Our brains are good at noticing patterns and drawing conclusions from a few basic features. Redundant features are those that repeat information or add detail and can be removed to make a very simple pattern (like a triangle and square for a house) that we can still identify. If too many of these features are removed, we make a guess based on the context. Filmmakers know that if they show us just enough of the shape of something in the context of the story, we will see it as they want us to see it.

4 Out of the Blue

When you see color, you sense light being reflected from an object to your eyes. Since plastic folders are not all alike, you will find that some combinations of red or yellow folders will create a filter to block blue/green light from getting to your eyes. This causes the "blue screen" to disappear, allowing the actors to be added to any scene—like E.T. and Elliot "flying" out of the neighborhood. A green "blue screen" is used for scenes where the actor is wearing blue so he or she won't disappear into the background.

What can that thundering sound be? Is it an earthquake? Wait a minute....no ... it's, it's *Tyrannosaurus rex* from *Jurassic Park* and she's headed this way! Yikes! Our heroes drive madly through the park, but the *T. rex* is close behind. Will they escape, or will they be caught and carried off, never to return? With movie special effects, it's all a matter of...

Monsters, Motion, and Mechanics

Bet you didn't know that a special effects artist is also a scientist! To create a realistic dinosaur takes more than a fossil skeleton. Artists also study how large animals move, the sounds they make, and how they behave in their environments. Pretty scientific, huh?

1 What happens to cars that hit a bump in the road?

2 Can you make a movie soundtrack?

3 What makes a convincing dinosaur?

4 How does Superman fly?

Stunt Car Drivers

Ever walk out of a movie having a conversation like this?: "Awesome. The car actually flips in the air, spins around, and crashes to the ground." "My favorite part was when that other car goes off the cliff." "Yeah, that was cool, too. How did they do that?" You can figure out how some of your favorite car-chase effects are produced.

● **You will need:** miniature racecars, strips of poster board about an inch wider than your cars, tape, large rubber bands, a clothespin, chairs, books, and whatever else you can think of to build the rough terrain, steep slopes, curves, and bumps of your chase scene.

● The strips of poster board are your road or track. Experiment with different designs until you find the one you like best for your chase scene. Tape the strips together if you need longer roadways. For a neat effect, include a bump somewhere in your design.

● Send your cars along their way and watch them closely. Where on the track do they speed up, slow down, or stop? How does the steepness of the track affect their speed? What do you need to do to make sure the car stays on the track after the bump? How does gravity affect the cars on your track?

● For your grand finale, how can you use your clothespin and/or rubber bands to make a car flip in the air, spin around, and crash? In the movies they use a "cannon car."

● Scientists know that when an object is moving in one direction, it tends to keep going that way. When does this happen with your car-chase effects?

2 What's Walla?*

What kind of sound does a dinosaur make? The sound of *Tyrannosaurus rex* in *Jurassic Park* included a mixture of noises from elephants, alligators, penguins, tigers, and dogs. Foley artists—special effects sound-makers—produce these sound effects. You can create your own soundtrack.

● **You will need:** a tape recorder, a cassette tape, paper, a pencil, a TV, a VCR, and a videotape of a favorite scene from a movie or TV show. Also gather up lots of things that can make noise, such as bottles with different amounts of water in them, rubber bands, old shoes, empty boxes, a cookie sheet, plastic grocery bags, and a fast-food drink cup with a lid and straw.

● Watch your videotape scene without the sound. Discuss ways in which you could change the scene with sound effects. Consider adding music or even making up new lines for the actors.

● Make a detailed list of all the sounds you want to create and how you might create them. Collect any additional noisemakers you will need.

● Watch the videotape and make the sounds, adding music and dialogue at the moments they should occur. Rehearse until your timing is just right.

● Make a tape of your new soundtrack and play it with the video.

● Every sound has a pattern of vibration. What vibrations did you notice in the objects you used? What vibrates when you tap on the bottle of water? What vibrates when you blow over the top?

● Why do you think it is possible to make two quite similar sounds using very different objects?

* A Foley artist's word for the background noise in a crowd scene. How would you create that?

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3 The Creature from the Backyard

What's the difference between Mickey Mouse and Mufasa? They're both cartoon animals. They both talk. But Mufasa seems so real. *The Lion King* filmmakers studied lions carefully so they could make Mufasa look real. For *your* next film, *The Creature from the Backyard*, you will be studying roly-poly bugs, or if you'd prefer, worms or spiders. After all, you're the director.
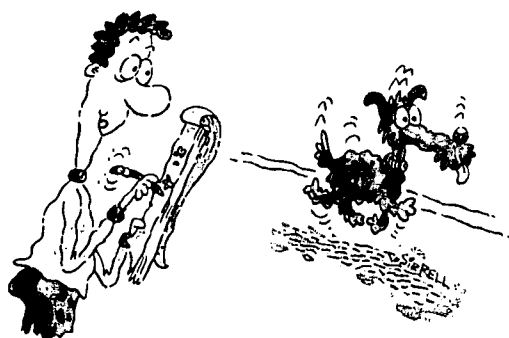
● **You will need:** an animal to observe, a notebook, a pencil, and lots of patience.

● Try to find an outdoor animal so that you can see it in its natural habitat. If not, a pet is OK, too. Sit quietly and observe your animal for ten minutes. Write in your notebook as many details as you observe.

● Pay careful attention to how your animal moves. Draw the animal in several stages of motion. Note the time of day and weather conditions for this first observation. Describe and draw the animal's habitat.

● Repeat this observation a second time at a different time of day and/or with different weather. It doesn't have to be

the exact same worm—a friend or relative will do. How do changes in the environment affect the way your animal moves?

● Based on what you now know about your animal, give it a name and a face. Draw a "storyboard" showing your animal character moving. A storyboard is a group of sketches drawn in the order they will appear in the movie. It's sort of like a comic book.

● How did your animal research affect the character you developed?

● How did you alter the animal's real characteristics in developing your cartoon animal? What did you keep the same? Why?
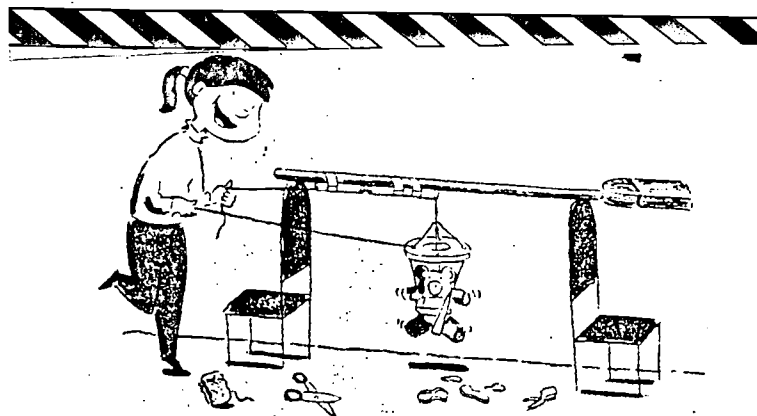
4 "It's a Bird, It's a..., It's Flying!"

Duck! It's Superman, swooping down from the sky! Or is that Peter Pan? Whatever it is, it flies—or at least it looks like it flies! Moviemakers use specialized machines to allow actors or models to "fly." You can make your own system to simulate flight.

● **You will need:** a broom with a long handle, two chairs, an action figure or a stuffed animal, rubber bands, heavy fishing line or string, a plastic lid (like from a coffee can), a paper punch, drinking straws, a spool or two, tape, and scissors.

● Suspend the broom handle between the two chairs (see illustration). This will hold your flight system.

● Using the rubber bands and string, create a supporting harness for your flying figure. Experiment until your figure hangs in the position you want.

● Is your figure balanced in the harness? Congratulations, you've discovered your figure's center of gravity. But it may not be in the center! Why did you put the harness where you did?

● Punch holes in the plastic lid. Using string, connect the flying figure to the lid so it hangs below the lid.

● Design a system that will connect the plastic lid to a single string. The string will be the main cable.

● Now be creative. Spools and pieces of drinking straws can be used to build a path for the main cable to follow. You want to be able to control the figure out of the view of the camera. Can you design a way to raise and lower the figure?

● Can you design a way to turn the figure? And what about moving the figure across the scene?

● Would you like to fly? If you were the one in the harness, what would you want to know about the design of the flying apparatus?

Tom Woodruff, Jr., left, with Alec Gillis

Close-Up

Alec Gillis and Tom Woodruff, Jr.

Job: Co-founders of Amalgamated Dynamics, Inc., a company specializing in "animatronic" (electronically controlled) creatures, monsters, and other characters for the movies. Won an Academy Award for their work on Death Becomes Her.

Duties: Create anything that can be imagined—including the robotic lion, spiders, and pelicans in Jumanji.

Major films: Starship Troopers, Jumanji, The Santa Clause, Wolf, Death Becomes Her, Alien 3

Education: Gillis: B.A. Film. Woodruff: B.A. Theater arts/Business administration

Advice for beginners: Gillis: "Become passionate about something and then pursue it." Woodruff: "When you see something you like, figure out what makes it work for you. Once you know that, it will help you create the same experience for other people."

The coolest thing about the job: Gillis: "It's very exciting to sit down with a script and a blank piece of paper and design characters—even 30-foot worms—with personalities." Woodruff: "Every day there's something new and different going on. It would be a crime to let something this much fun become boring!"

Behind the Scenes

1 Stunt Car Drivers

You've been experimenting with forces of motion. Gravity keeps pulling your car toward the earth. The steeper the hill, the faster the car goes. When it goes over a bump and into the air, gravity pulls it down, but momentum, another force, keeps it traveling forward. A "cannon car" works by applying a strong force under one side of the car, causing it to flip up in the air. Motion is therefore transferred from the cannon to the car. A moving car eventually slows down and stops because of the friction of its wheels against the track and of the car body against the air.

2 What's Walla?

To reproduce a sound you must simulate its pattern of vibration. Different things can be used to create the same pattern. You can see the vibration when the water moves in a bottle. When you use a tape recorder, you're reproducing a vibration, too. You can hear because your ear channels these vibrations to your eardrum. The vibrations are amplified and travel into the inner ear, where they are translated into nerve impulses which the brain interprets as sound.

3 The Creature from the Backyard

From walking to running, from running to flying, an animal changes the way it moves when something changes in its environment. Filmmakers use scientists' knowledge of animal movement and behavior to develop convincing animal characters. In the best animation, a talking cartoon animal still moves with the distinct gait of its "cousin" in the backyard.

4 "It's a Bird, It's a ..., It's Flying!"

The center of gravity of an object represents the point at which the total object is pulled by the force of gravity. It influences the position an object takes when it is suspended. Since this point is not necessarily the middle of an object, harnesses must be designed to adjust for this point on an object or a person. The apparatus used to control the flying motion of actors in a film is a complex machine made up of simple machines working together.

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What a face! With a face like that, he ought to be in pictures. We all know him as Chewbacca, Han Solo's loyal friend in the *Star Wars* movies, but how did special effects artists create that hairy face we've grown to love? What materials are makeup and masks made of? Does matter matter? For the answers to these and other chem-mysterious questions, discover ..

Mysterious Makeup, Preposterous Props

1 How do you create frost that never melts?

2 When can chicken bones come to life?

3 When is a giant boulder mighty in size and small in weight?

4 What different forms of matter can you create?
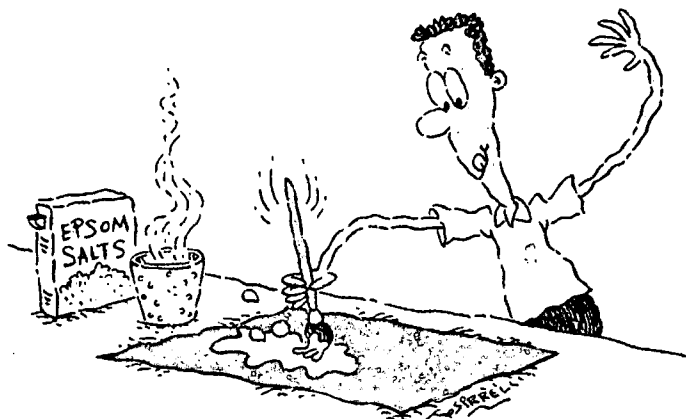
From start to finish, making the mask for Chewbacca requires knowledge of chemistry. The properties of different forms of matter must be understood to create just the right material—rubbery latex, for example—for Chewie's hairy head. Special effects chemistry creates the makeup for blending Chewbacca's mask into the actor's real face and also creates the space-age props Chewie uses.

A Frosted Window-pane

Problem: Your scene takes place in winter when the windows are covered with frost, but you're filming in the studio under bright lights. The Solution: A solution—an Epsom salts solution, that is.

● **You will need:** Epsom salts, a plastic foam cup, hot tap water, a spoon, a small paintbrush, and dark construction paper.

● Pour some Epsom salts out of the box and look at them closely. Study their shapes.

● Fill the cup halfway with hot water.

● Stir in Epsom salts until they dissolve and you can see a layer of salt collecting at the bottom of the cup.

● Dip your brush into the top half of the cup and paint the solution onto the construction paper. What happens as it dries?

● Compare the shape of you "frost" to the salts you poured out of the box.

◉ Why might the window-pane effects created with Epsom salts work better for the movies than real frost?

● Your simulated frost is actually made of crystals. Do you know how the crystals are formed? What do you think crystals are?
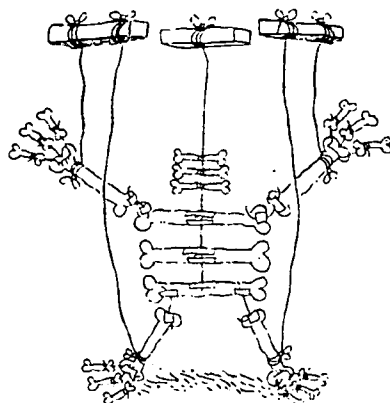
2 A Bone to Pick

How did special effects artists make E.T.'s mask look so real? Chemistry. They figured out how to mix together materials to get that rubbery, crinkled look. Sound like fun? You can make a chemical reaction in your own kitchen and make a chickenbone skeleton come to life! "But those bones are so stiff," you say. "How can I make them bend and move?" Nothing a special effects artist (you!) can't solve.

● **You will need:** clean chicken bones, a clear glass jar (like a mayonnaise jar), vinegar, a book about skeletons or anatomy, fishing line, scissors, and tape.

● Study the chicken bones carefully. What properties do they have that make a good skeleton for a chicken? Break a bone in half. What does it look like inside?

● Fill the glass jar about halfway with vinegar. Drop in the bones and let them soak overnight. (Larger bones may take two or three nights of soaking.) How have they changed by morning? Why?

● Try breaking a bone in half. What's different? Do the bones feel heavier or lighter than before? Which kind of bones do you think would be better for a chicken?

● In your book about skeletons or anatomy, study how a skeleton fits together.

● Dry the bones with a paper towel and build a skeleton creature out of them. Begin by taping the ends of a short piece of fishing line to one end of each of two bones. Continue building until you have put all the bones together the way you want them.

● Write a story using your special effects skeleton. If you would like to act out your story, attach longer pieces of fishing line to the skeleton and to one or two sticks that you can hold above the skeleton to make it move like a marionette.

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3 Prop Rocks

Our superhero dashes through the landslide tossing huge rocks aside. Finally, arriving just in time, our hero catches a mighty boulder in midair, saving a terrified victim from its crushing blow. You've seen actors perform feats of strength even more amazing than boulder-tossing. Can they really be that strong? To find out more, set up this "Big Rock Challenge" with your friends.
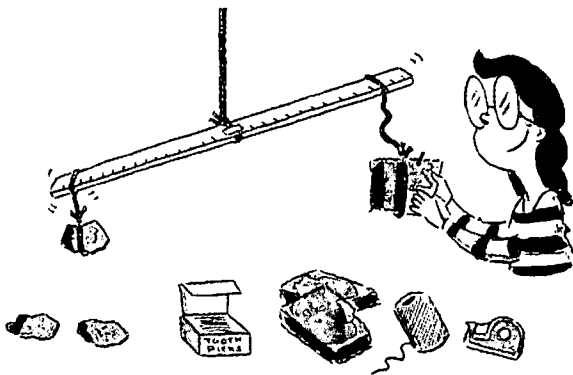
- **You will need:** a yardstick, string, tape, a real rock (2 or 3 inches across), an assortment of large plastic-foam pieces left over from packing cartons, and toothpicks.

- The idea of the challenge is to create the biggest plastic-foam boulder possible with the same mass as the rock. A balance, made from the yardstick, will be used to compare the real rock to the special effects boulder.

- Build a balance like the one shown above to compare your prop rock to the real thing.

- With a piece of string and some tape, suspend the rock from the 1-inch mark at one end of the stick. Hang all of the boulders you create from the 35-inch mark at the other end.

- Build your first boulder from plastic foam. You can fasten pieces together with toothpicks or tape and tear

chunks out to lessen the size or improve the look. Then hang your boulder opposite the rock on the balance. Add or subtract foam until the yardstick is parallel to the floor and the two have nearly the same mass.

- What clues does your plastic-foam boulder give you about the rocks used in the movies?

- Does your prop look enough like a boulder to be believable? What else would you need to do to make this special effect do the job?

- What other materials or designs could you use to build a better boulder and beat the Big Rock Challenge? You might try papier-mâché, hollow objects, or different kinds of foam.

- How would you need to handle this prop rock for the action to look realistic?

4 Mad Scientist's Lab

"Mad" scientist? Get real. Real-life scientists are pretty much like the rest of us except that they have a lot of experiments to show you, some of which can make great special effects.

- For "secret potions," **you will need:** cut-up red cabbage, an adult, boiling water, a strainer, three empty jars, lemon juice, and liquid soap. Ask the adult to boil some water for you and help you put some cut-up red cabbage into the boiling water. Let the cabbage sit for a while until the water has cooled off and turned nice and pink. **Do not touch the water until the adult tells you it's cool enough.** Then strain off the juice. You can ask the adult (nicely) to go away now so he or she won't get in on the secrets behind your special effects.

- Arrange three empty jars, putting a little lemon juice in one, a little soap in another, and nothing in the third. Pour some cabbage juice into each jar and see what happens. **Do not drink any of your potions.** Blech! Worse than carrots.

- Why does the cabbage juice react differently to some substances than to others? Try mixing the cabbage juice with other things you find in the kitchen, like baking powder or vinegar, and see what happens.

- For "mysterious ooze," try mixing cornstarch and water in a cup. Start with 1 tablespoon of cornstarch and gradually add dribbles of water, then a little more cornstarch, then a little water, until you get just the ooziness you want. Is the ooze a solid or a liquid? "Eeew! It's oozing across the table! Somebody stop it!" Food coloring will create a rainbow of different oozes.

- By the way, these mad-scientist activities involve real science. What are the features of the things you created? How are the new creations different from the substances you combined to make them?

Close-Up

Joe Viskocil

Joe Viskocil

Job: Coordinator of miniature pyrotechnic effects

Duties: Plans and safely executes small explosions to make them look big.

Major films: Star Wars, The Empire Strikes Back, Terminator and Terminator 2: Judgment Day, True Lies

Education: Two years of college photography, drama, and arts; on-the-job training in chemistry, film technique, and fire-and-safety regulations.

Advice for beginners: "Find something that nobody else can do and then apply that to the movies. When I started out, there was no one who specialized in miniature pyrotechnic effects, so I became that person."

The coolest thing about the job: "I usually get to do the ending of the movie, where the most spectacular thing happens. I blew up the Death Star in Star Wars and had the audience cheering!"

Play's the Thing

Ask a librarian to help you find a play or screenplay you can read. How is it different from reading a book? Where do you think special effects might be needed? What makeup and props would you need? What role would you like to play yourself?

Behind the Scenes

1 A Frosted Windowpane

Your frosted window-panes never melt because they're made of Epsom salts, not frozen water. Epsom salts are a substance with very different properties. First, you made a solution—a solid dissolved in a liquid. Then the solid crystals re-formed when the water in the solution evaporated. The crystals on the paper have the same shape as the ones you poured out of the box.

2 A Bone to Pick

A chemical reaction occurs between the bones and the vinegar, producing a new material with different properties (elasticity) from the originals. There is a chemical in the bones that combines with the vinegar to get this effect. When you break the chicken bone in half before it is soaked, you can see little holes inside. A bird's bones have hollow spaces inside that make them lighter, making it easier for the bird to fly.

3 Prop Rocks

When the balance is level, the prop rock has the same mass as the real rock. At first glance, the obvious difference is size. However, from a scientific standpoint, the difference is one of density. Density is a property of materials that describes the amount of mass in a particular amount of space. Most rocks and metals have a lot of mass in a small space, or a high density. Prop boulders, on the other hand, are made from low-density materials.

4 Mad Scientist's Lab

"Secret potions": Cabbage juice is an "indicator," a chemical that changes to different colors when exposed to other chemicals such as "acids," like the lemon juice, or "bases," like the soap. You performed a "pH test," one of many kinds of tests used by chemists. "Mysterious ooze": Chemists call your ooze a "suspension." The cornstarch does not dissolve in the water, so the ooze is not a solution. It is neither a solid nor a liquid. It has properties of both. Both creations are different forms of matter.

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Can you imagine Luke Skywalker without his buddies R2D2 and C3PO? Or Captain Picard without Data? Computers and robots star in many of our favorite movies and shows, but did you know that they're just as important behind the scenes? With computer animation, special effects have become so mind-boggling, it would make C3PO blow a fuse. But not you. Turn the page to enter the world of...
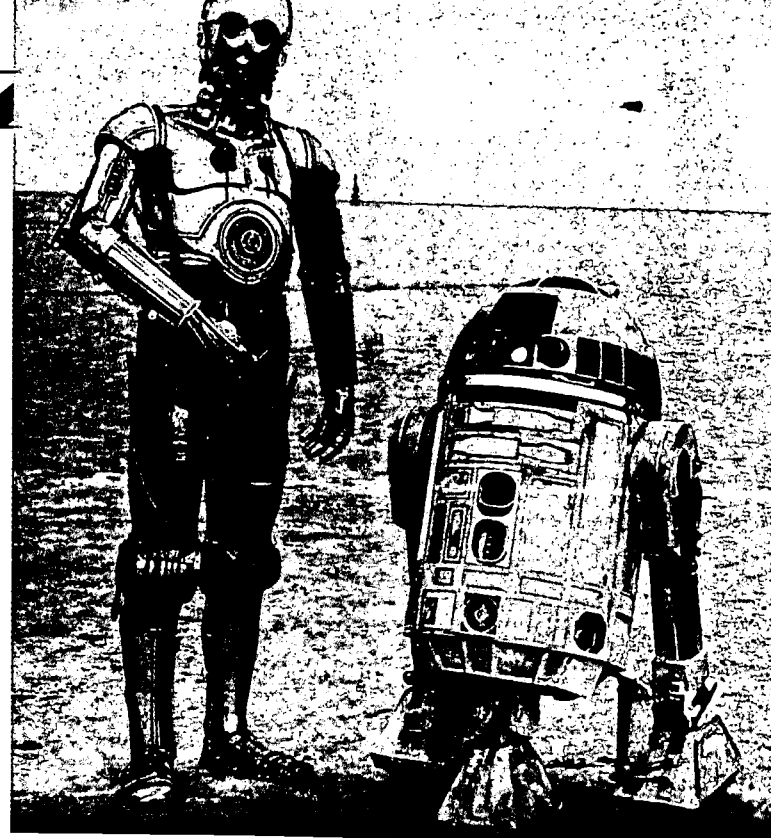
High-Tech Reality

The difference between your brainpower and C3PO's means that you (and other scientists) can understand what goes on in our world and you (and other engineers and special effects artists) can use that knowledge to create things. The more you know about light, color, electricity, and computer technology, the more high-tech your special effects can become.

1 When is the perfect animated creature too good to be true?

2 Who needs circuits more—a movie cowboy or a computer animator?

3 What do you need to make an image look real?

4 How can you get a computer to lend a hand?

Hey, cool questions. Find out more on the next page.

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Too Good to Be True

Computer-developed images allow moviemakers to film adventures using creatures and scenes they've created from their imaginations. With the computer, one creature can be copied to make an entire crowd. But do real animals or even twins ever look exactly alike? You can explore the challenge moviemakers had in making the wildebeest stampede in the The Lion King.

● **You will need:** a picture of a wildebeest from a computer clip-art program or a book. (What? You can't find a wildebeest? Okay, another animal will do.) You'll also need a photocopier and scissors.

● Use a computer to copy the art five times and put six of the same animals in the same scene. If you don't have a computer, you can use a photocopier to make six copies of the animal. Then cut them out. Six identical ads or flyers can be used, too.

● Move the identical images around to try and create a realistic looking scene (e.g., animals in a herd, people in a crowd, or plants in a garden). Add additional scenery using the computer graphics program or markers. Can you make the scene look real?

● Like scientists, moviemakers study the differences among animals, even among those of the same species, that arise from inherited traits and changes caused by injury and development. Use the computer to make alterations to each image, such as the look of the skin, or slightly move the position of some part of the image. How do your effects help improve the real look of the group?

● If you are using copier or cut-out images, use markers, white correction fluid, or even scissors to create changes in the perfect copies. Which changes are the most effective for a more true-to-life look?

● Computers can create perfect images, but what happens if they are too good to be true?

Want to know more about your discoveries? Check out **Behind the Scenes** on page 24.

Happy Trails, Mr. Circuit

Howdy, pardner. What do cowboys and computers have in common? The same thing that lets the computer respond when you move the joystick is what lets the movie cowboy always hit the can on the fence post—circuits! You can make your own special effect using a simple circuit.

● **You will need:** two 18-inch pieces of insulated copper wire, two flashlight bulbs, two size-D batteries, masking tape, markers, scissors, index cards, glue, and one adult.

● Use the scissors to peel the insulation off the ends of the wires. How can you connect a bulb, wires, and a battery to make the bulb light? Try it different ways until you've shown your adult how it works. When you succeed, you've made a circuit! Draw a picture of how it worked.

● Now for the special effect. Your scene requires that lights go on mysteriously, go off mysteriously, or blink mysteriously. Create a story using this idea.

● Draw and cut out scenery and actors and glue them to your index cards.

● Wire your circuit so that the battery and wires can't be seen. (You can hide them behind your set.) For a bigger effect, add an extra bulb and battery. Then play out the scene with your new circuit.

● Here are a few questions to think about. What are the parts of the circuit you built? What does each part do? What special effects have you seen that might use circuits? Why would circuits be useful for the effect?

● The next time you see that cowboy shoot a hole in each tin can without a single miss, think about circuits. When the switch is pulled, the cans go off before you can say "Whoopee TiYiYo." The cowboy doesn't have real bullets so it doesn't matter where he aims!

3 A Square Image

Ever look closely at the printout from a computer or the image on a screen in a video arcade? Can you see the pattern of squares? If you have a computer, try printing out the same word in small letters and again in very large letters. See those squares again? Computer animators want as much detail as possible to make their images realistic, but they're limited by those same patterns of squares. How has technology overcome these limits? Let's find out.
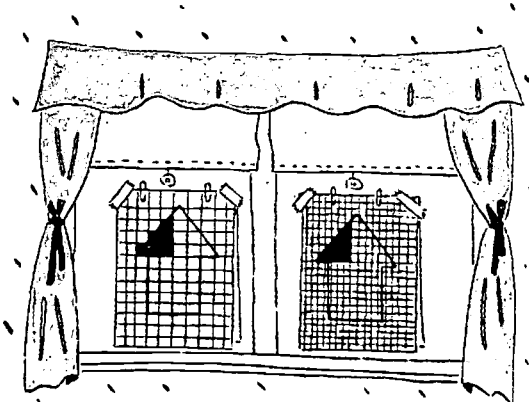
● **You will need:** a simple black-and-white picture that is clear and easy to recognize (a blurry image with lots of grays and detail won't work well); two pieces of graph paper, one with 16 squares per inch and one with 100 squares per inch; a pencil; tape; two paper clips; and a window or other light source.

● Clip the 16-square graph paper to the front of the picture. Tape the two pieces of paper to the window so that the light shines through.

● Look at each square of the graph paper and decide:
a Is more than 50 percent of the square of the picture shaded? If so, color the graph square black.
**b** Is less than 50 percent of the square of the picture

shaded? If so, leave the graph square white.
c Is the square of the picture shaded, but only lightly? If so, leave the graph square white. Continue until all your squares are colored, or left white, using this system.

● Study your image up close and at a distance. What features in the original picture can you also identify from the graph paper?

● Try the same activity but this time use the 100-square graph paper. Compare the two images. What would you need to do to make your image even more realistic? What developments in computer technology would be important to this process?
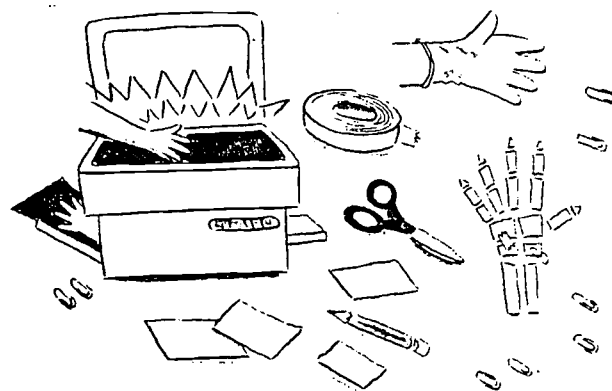
4 Give Me a Hand

In *Jurassic Park,* computer animators took fossil skeletons and brought them to life with terrifying results. Can you do the same thing with your own hand? Here are three animation problems that computers can solve.

● **You will need:** a photocopier, a pencil, paper, a latex or tight-fitting glove, small pieces of cardboard, scissors, paper clips, and masking tape.

● Make a photocopy of your hand. Compare the copy to your real hand. Write down the similarities and differences between the two. What would you need to do to the photocopy to make it more like the real hand?

● Draw a picture of a small part of your hand (about two square inches), putting in as much detail as possible.

● Put a latex or tight-fitting glove on one hand. Lay the gloved hand on the table without moving it. What is it about the gloved hand that makes it no longer seem real (or alive)? Compare it to your drawing.

● How does a real hand move?

● Use the small pieces of cardboard, scissors, paper clips, and masking tape to build your own hand skeleton. Cut the bones out of cardboard. Connect the bones by taping each end of an unfolded paper clip to each bone so that they can move.

● Write a story about a hand using the photocopy, the gloved hand, and the movable skeleton. Act out your story for your friends.

● Which hand did you use in which scene? Why did you choose the one you did?

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Close-Up

Ellen Poon

Job: Visual effects supervisor for Industrial Light & Magic

Duties: Heads team that creates special effects for movies and commercials. Specializes in computer graphics.

Major films: Jurassic Park, The Mask, Jumanji

Education: B.Sc., Ph.D. Computer science

Advice for beginners: "Explore every interest you have. If you're like me and enjoy drawing and computer programming, you don't have to give up either one. Do both!"

The coolest thing about the job: "I can create an entire universe with computer graphics. It's like having an infinite number of pencils and brushes."

Ellen Poon

Behind the Scenes

1 Too Good to Be True

In the making of The Lion King, creating a stampede was a challenge. If the wildebeests were to look or move too much alike we would guess that they were made by computer. Careful observation reveals that animals of the same species, identical twins, and even the right and left sides of a face are not exact copies. Though the computer allows the generation of perfect-match images, they are indeed too good to be true.

2 Happy Trails, Mr. Circuit

Your circuit includes a battery, which gives it power; the wire through which the energy travels; and the bulb, which uses the energy to produce light. A circuit will work only when it is connected without any breaks. When you disconnect the wire from the battery, you're turning off the switch. Circuits are important for special effects, like explosions, that must be activated from a distance. Elaborate computer special effects are possible only because of circuits.

3 A Square Image

Computer technology has developed to enable us to make smaller and more detailed images. The more squares per inch in your graph paper, the better the quality of your image. Today's computers transmit images allowing for thousands of squares per inch. This can make something two-dimensional appear three-dimensional. A computer-animated character requires this high density of information to look real.

4 Give Me a Hand

Computers have a lot to offer. Unlike the two-dimensional image made by a photocopier, you can scan all sides of a real object and make a three-dimensional picture on the computer. To make a gloved hand look real, a technique called texture mapping adds intricate detail to the surface of an object. Models like your skeleton can be connected to computers so that the motions you make can be duplicated and altered. The computer can even combine all three of the activities you did into one realistic moving image. Many movies use a combination of the above techniques.

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Glossary

animation
A sequence of drawings viewed quickly one after another, giving the illusion of continuous motion.

blue screen
A blue- or other color -lit screen used as a backdrop for filming action that will later be combined with a background scene that is shot separately.

computer animation
Animation created with the aid of a computer that can simulate realistic motion, lighting, and color.

depth
How near or far away something is.

illusion
An erroneous perception of reality.

matte
A device or piece of film that allows part of a film frame to be blacked out so that a separate image can be added later.

matte painting
A realistic painting that is combined with live-action scenes.

perception
A process in which a sensory organ, such as the eye, feeds the brain information about what it sees and the brain interprets that information based on relevance to current events as well as previous experiences.

persistence of vision
The perception of rapid flicker as a steady light, a principle that makes movies seem realistic.

perspective
The illusion of depth formed when familiar objects are seen with different sizes.

relative motion
The change of position of one thing in relation to another.

special effect
Any shot designed to create an illusion on film.

stop motion
The technique of making an inanimate object come to life by filming it one frame at a time, gradually moving it between exposures.

Books We Recommend

Andersen, Yvonne.
Make Your Own Animated Movies and Videotapes. 2d ed. Boston: Little, Brown, and Co., 1991.

Ardley, Neil.
The Science Book of Color. New York: Harcourt Brace Jovanovich, 1991.

Conklin, Thomas.
Meet Steven Spielberg. New York: Random House, 1994.

Exploratorium Teacher Institute. *The Exploratorium Science Snackbook.* San Francisco: The Exploratorium, 1991.

McCarthy, Robert E.
Secrets of Hollywood Special Effects. Boston: Focal Press, 1992.

Platt, Richard.
Film. New York: Alfred A. Knopf, 1992.

Samonek, Michael E.
Special Effects Cookbook. Narberth, PA: MES/FX Publishing, 1992.

Scott, Elaine.
Look Alive: Behind the Scenes of an Animated Film. New York: Morrow Junior Books, 1992.

Shay, Don, and Jody Duncan.
The Making of Jurassic Park: an Adventure 65 Million Years in the Making. New York: Ballantine Books, 1993.

Smith, Thomas G.
Industrial Light & Magic: The Art of Special Effects. New York: Ballantine Books, 1986.

The Smithsonian Institution.
Science Activities. New York: GMG Publishing and Science Learning, Inc, 1987.

VanCleave, Janice.
200 Gooey, Slippery, Slimy, Weird & Fun Experiments. New York: John Wiley & Sons, Inc., 1993.

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Sign here, → please	Signature:	Printed Name/Position/Title: Karen Hartley Project Director
	Organization/Address: WGBH / 125 Western Ave (Boston, MA 02134	Telephone: (617) 300-3864 FAX: (617) 300-1040
		E-Mail Address: Date: 9/13/99